

REMARKS

Claims 11, 16 and 20-29 have been canceled, and claims 30-33 have been added. No new matter was added. Accordingly, claims 2, 12-15, 17-19 and 30-33 are pending for further prosecution. Independent claim 2 had been amended to distinguish over the prior art of record. Applicant respectfully submits that the present application is in condition for allowance.

I. Claim Objections

In the Office Action, correction of a typographical error in claim 15 is requested.

Claims 15 and 19 of the present application have been amended to correct a typographical error. The term “macro structure” has been replaced with the word “macrostructure” in each of the claims. No new matter was added. Applicants respectfully request removal of the objection.

II. Claim Rejections - 35 USC §102(b)

In the Office Action, claims 24-28 are rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 6,331,233 B1 issued to Turner.

Claims 24-28 directed to a Ta sputtering target have been canceled. Accordingly, this rejection is now moot and can be withdrawn.

III. Claim Rejections - 35 USC §103(a)

In the Office Action, claims 2, 11-23 and 29 are rejected under 35 USC §103(a) as being obvious over U.S. Patent No. 6,331,233 B1 issued to Turner.

Independent claim 2 of the present application has been amended to include the limitation previously stated in claim 11. No new matter was added. Thus, claim 2 requires the ingot to be forged and then annealed at a temperature of 1373K to 1673K, and this set of steps is required to be performed twice during the claimed process. In addition, claim 2 requires that after one of these sets of steps that the ingot be forged or rolled and then annealed at a temperature between recrystallization starting temperature and 1373K. Thus, the claimed method requires the ingot to be annealed at a high temperature (1373K to 1673K) and then again at a different and lower temperature (between recrystallization starting temperature and 1373K).

New independent claim 30 includes similar limitations with respect to high-temperature followed by low-temperature annealing. It also requires the Ta raw material to have a purity of 4N5 (99.995%) or more. No matter was added; for example, see page 5, line 22, of the present application, as filed. Further, new dependent claims 32 and 33 require the “additional” or low-temperature annealing to be conducted at a temperature of 1173K, which is well below the high-temperature annealing step (1373K to 1673K). No new matter was added; for example, see page 7, lines 2-4 (Example 1) and lines 24-31 (Example 2).

The cited prior art reference, Turner, clearly requires “a minimum of three stages each of which includes a deformation step followed by an inert atmosphere high-temperature anneal”. For instance, on column 4, lines 18-20, Turner teaches that “The process of this invention ... utilizes no less than three inert-atmosphere anneal steps”. The “high-temperature anneal” steps are stated as being “preferably between 2200°F and 2400°F” (1477K and 1589K).

Accordingly, Turner teaches to one of ordinary skill in the art to repeat forging, rolling or extrusion deformation followed by high-temperature recrystallization annealing for at least three times. Turner clearly fails to teach, suggest or disclose performing high-temperature recrystallization annealing and thereafter switching to a different and lower temperature annealing as required by the claims of the present application.

The requirement of claims 2 and 30 of the present application to perform annealing at a high temperature and thereafter at a significantly lower temperature provides a significant advantage and unobvious improvement relative to the process disclosed by Turner. High-temperature annealing followed by low temperature annealing permits recrystallization of the ingot or billet to be performed gradually. It also inhibits coarsening of grains while promoting uniform grain growth, thereby providing a fine structure. In contrast, if all three or more annealing process steps are performed at a high temperature as taught by Turner, excessive crystal growth will occur during recrystallization which will result in the formation of coarse crystals, or since a part of the structure may show abnormal grain growth, a uniform and fine structure cannot be obtained.

For at least these reasons, Applicant respectfully submits that independent claims 2 and 30 of the present application are non-obvious and patentable over Turner.

Still further, Applicant respectfully submits that the disclosure of Turner is directed to a tantalum target having a structure in which a desired crystal orientation spreads out in a disk shape (or convex lens shape) toward the center of the target (i.e., in a thickness direction of the target). Turner describes that a target having the desired kind of crystal structure is able to inhibit the rapid growth of erosion since the desired orientation with a low sputter rate in comparison to other orientations appears in the erosion midway during the progress of erosion,

and the sputtering rate can thereby be made uniform until the last stages of sputtering. (For example, see the discussion on column 2, lines 44-61, of Turner.)

The crystal structure desired by Turner is obtained by repeating forging and high-temperature recrystallization a minimum of three times. To control the structure of the crystal orientation desired by Turner in the thickness direction of the target, knead forging (which repeats upset forging and extend forging) is required to be performed, and cross rolling (i.e., multi-direction rolling) and high temperature annealing are performed after the forging. Thus, to control the orientation in the thickness direction of the target, that is, in order to form a structure in which the desired orientation spreads out in a disk shape (or convex lens shape) toward the center of the target, cross rolling is required. The crystal orientation disclosed by Turner cannot be obtained without cross-rolling.

Turning to the present invention, it does not relate to controlling orientation; rather, it provides a tantalum target capable of completely eliminating a pattern in the form of wrinkles or streaks from the center to the peripheral edge of the disk which affects the uniformity of the film produced by sputter deposition. To completely eliminate this kind of pattern (i.e., wrinkles or streaks) as well as to densify the structure of the target and increase its strength, forging and recrystallization annealing is performed at a high temperature (1373K to 1673K), and thereafter annealing is performed at a low temperature (between the recrystallization temperature and 1373K).

As discussed above, Turner performs cross-rolling (multi-direction rolling) to control the structure of the desired crystal orientation in the thickness direction. In contrast, the present invention is unrelated to technology of controlling the structure of the orientation in the thickness direction. Thus, cross rolling (i.e., multi-direction rolling) is not used in the process of the present application. Accordingly, there are significant differences between the process of Turner

and the process of the present invention, and therefore, there are significant differences between the target obtained by Turner and that obtained by the present invention. Applicant respectfully submits that it is incorrect to assume that a target having no uneven macrostructure in the form of streaks and aggregates on the surface or inside the target would be obtained or would be expected to be obtained by the process disclosed by Turner.

For this additional reason, Applicant respectfully submits that claims 2, 12-15, 17-19 and 30-33 are patentable and non-obvious relative to Turner. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

Finally, with respect to claim 30, the Ta raw material is required to have a purity of 4N5 or greater. Turner clearly requires the raw material to have a purity of 3N5 (see column 3, line 6).

IV. Conclusion

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to
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